NON-PUBLIC?: N
ACCESSION #: 9109180125
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Palo Verde Unit 2 PAGE: 1 OF 8

DOCKET NUMBER: 05000529

TITLE: Manual Reactor Trip During Shutdown
EVENT DATE: 08/09/91 LER #: 91-003-00 REPORT DATE: 09/05/91

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 40

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
NAME: Thomas R. Bradish, Compliance TELEPHONE: (602) 393-2521
Manager

COMPONENT FAILURE DESCRIPTION:
CAUSE: X SYSTEM: CD COMPONENT: FAN MANUFACTURER: J127
X EA BKR G080

REPORTABLE NPRDS: NO
NO

SUPPLEMENTAL REPORT EXPECTED: No

ABSTRACT:

At approximately 0648 MST on August 9, 1991, Palo Verde Unit 2 was in Mode 1 (POWER OPERATION) at approximately 40 percent power when the reactor was manually tripped due to Axial Shape Index (ASI) approaching its trip setpoint on the Core Protection Calculator. At the time of this event, the reactor was being shut down due to the loss of Control Element Drive Mechanism cooling fans. Following the trip, two of the four reactor coolant pumps (RCPs) did not transfer to their alternate source of power and stopped. The remaining two RCPs supplied adequate forced circulation. The reactor trip was diagnosed as an uncomplicated reactor trip. No safety system responses occurred and none were required. At approximately 0658 MST the plant was stabilized in Mode 3 (HOT STANDBY) at normal temperature and pressure.

The cause of the manual reactor trip was ASI approaching its trip setpoint during shutdown. The corrective action was to trip the reactor and ensure ASI remained within limits.

Previous similar events were reported in LER 528/87-018-01 and LER 529/90-001-00.

END OF ABSTRACT

I. DESCRIPTION OF WHAT OCCURRED:

A. Initial Conditions:

At approximately 0648 MST on August 9, 1991, Palo Verde Unit 2

was in Mode 1 (POWER OPERATION) at approximately 40 percent power. At the time, the unit was in the process of shutting down.

B. Reportable Event Description (Including Dates and Approximate Times of Major Occurrences):

Event Classification: Any event or condition that resulted in manual actuation of the Reactor Protection System (RPS) (JC).

At approximately 0648 MST on August 9, 1991, while shutting down due to the loss of control element drive mechanism (CEDM) (AA) cooling fans (FAN) (CD), the Unit 2 reactor (RCT)(AC) was manually tripped by a reactor operator (utility, licensed) due to Axial Shape Index (ASI) approaching its trip setpoint on the Core Protection Calculator (CPU)(JC) during an end of core life shutdown. Following the reactor trip, the turbine (TRB)(TA) tripped and one (1) of two (2) non-class 13.8 kV busses (NAN-S01)(BU)(EA) failed to fast transfer from the unit auxiliary transformer (XFMR) (EA) to the startup transformer (XFMR) (EA). This resulted in two (2) of the four (4) reactor coolant pumps (RCP)(P)(AB) stopping. At approximately 0649 MST the non-class 13.8 kV bus (NAN-S01) was reenergized. The two (2) RCPs were not restarted since the two (2) operating RCPs provided sufficient forced flow. By approximately 0658 MST, the plant was stabilized in Mode 3 (HOT STANDBY) at normal temperature and pressure. The reactor trip was diagnosed as an

uncomplicated reactor trip. No safety system responses occurred and none were required.

ASI is defined as "the power generated in the lower half of the core less the power generated in the upper half of the core divided by the sum of these powers" (Technical Specification Definition 1.2). ASI is calculated in each of the four (4) Core Protection Calculator Channels. When a Core Protection Calculator Channel calculates an ASI greater than .50 or less than minus .50, it generates a trip signal to the Plant Protection System (JC). The Plant Protection System has a two-out-of-four logic thus requiring ASI trip signals from two (2) of the four (4) Core Protection Calculator Channels to initiate a reactor trip.

CEDM cooling is provided by four (4) CEDM cooling fans. At least one (1) CEDM cooling fan is required to be operating to maintain

CEDM temperature. Prior to this event two (2) of the Unit 2 CEDM cooling fans had been taken out of service due to previously identified ground faults. One (1) CEDM cooling fan was operating and the other CEDM cooling fan was in standby.

At approximately 0510 MST on August 9, 1991, the operating CEDM cooling fan tripped on ground fault. The standby CEDM cooling fan was immediately started. At approximately 0610 MST on August 9, 1991, the remaining CEDM cooling fan tripped on ground fault. At approximately 0617 MST, Control Room personnel (licensed, utility) initiated a plant shutdown due to the loss of CEDM cooling fans, in accordance with an approved procedure. The procedure required that the plant be shut down by boration within 30 minutes. Therefore, control rod movement was not used for ASI control. At approximately 0642 MST, the required ACTIONS of Technical Specifications Limiting Condition for Operation 3.2.3 and 3.2.7 were entered when azimuthal power tilt (power asymmetry between azimuthally symmetric fuel assemblies per Technical Specification Definition 1.3) exceeded its limit in Figure 3.2-1A of Technical Specification 3.2.3 and ASI exceeded its limit in Technical Specification 3.2.7.a.

At approximately 0648 MST, Unit 2 was at approximately 40 percent power when the reactor was manually tripped as ASI reached -.45. Following the reactor trip, the turbine tripped

and one (1) of two (2) non-class 13.8 kV busses did not fast transfer from the unit auxiliary transformer to the startup transformer. This resulted in two (2) of the four (4) RCPs stopping. At approximately 0649 MST, the non-class 13.8 kV bus was reenergized. The two (2) RCPs were not restarted since the two (2) operating RCPs provided sufficient forced flow. The unsuccessful bus transfer also resulted in the loss of the operating nuclear cooling water pump (P) (CC) and loss of letdown flow for approximately 10 minutes due to the loss of nuclear cooling water instrumentation. The standby nuclear cooling water pump automatically started as designed. At approximately 0658 MST the plant was stabilized in Mode 3 (HOT STANDBY) at normal temperature and pressure.

Following the manual reactor trip all steam bypass control valves (SBCV) (FCV) (SB) modulated open as required except for one SBCV which did not open during this event. The SBCV should have modulated open to approximately 34 percent.

C. Status of structures, systems, or components that were inoperable at the start of the event that contributed to the event:

Other than the CEDM cooling fans discussed in section I.B, no structures, systems or components were inoperable at the start of the event which contributed to this event.

D. Cause of each component or system failure, if known:

1. The initial evaluation of the CEDM fan failures has determined that they were due to bearing failures. The final root cause of failure evaluation is expected to be completed by May 1, 1992. If the final evaluation results in any changes to this determination, a supplement to this report will be submitted.

2. The cause of the non-class 13.8 kV bus (NAN-S01) not fast transferring from the unit auxiliary transformer to the startup transformer was a loose and misaligned early 'b' contact (SWGR) (EA) on the normal supply breaker (BKR) (EA) to bus NAN-S01. When the normal supply breaker opens, the early 'b' contact allows a close signal to be sent to the crosstie breaker. If the response time for the early 'b' contact is too slow, the auxiliary

transformer and startup transformer will not be synchronized and the close signal will not be sent to the crosstie breaker.

Investigation and troubleshooting of the failure found that the early 'b' contact was loose and misaligned. A loose wire connection was also found on the early 'b' contact. Response time testing for the early 'b' contact had inconsistent results, with some values exceeding the maximum allowed response time. The wire connection was secured and the early 'b' contact was aligned and secured. Subsequent response time testing resulted in consistent times well within the maximum allowed response time, Based on the results of the investigation and troubleshooting PVNGS engineering concluded that the cause of the bus not fast transferring was the slow response time of the early 'b' contact on the supply breaker.

The cause of the early 'b' contact being loose and misaligned could not be determined. A review of manufacturer recommended maintenance and inspection requirements did not identify any specific requirements for the early 'b' contact nor has PVNGS experienced any previous problems with the early 'b' contact.

3. The cause of the steam bypass control valve not opening could not be determined. The valve was tested after this event and operated satisfactorily.

E. Failure mode, mechanism, and effect of each failed component, if known:

The failed CEDM cooling fans resulted in loss of CEDM cooling and shutdown of the plant as described in Section I.B.

The malfunctioning early 'b' contact in the normal supply breaker for the non-class 13.8 kV bus resulted in the bus not fast transferring from the unit auxiliary transformer to the startup transformer. This resulted in two (2) of the four (4) RCPs stopping as described in Section I.B.

In June 1989, design changes were implemented to upgrade the overall design of the fast bus transfer system. Since

June 1989, there have been nine plant trips at PVNGS. The fast bus transfer operated successfully in each of these events, except for the unsuccessful fast bus transfer described in this report.

F. For failures of components with multiple functions, list of systems or secondary functions that were also affected:

Not applicable - no failures of components with multiple functions were involved.

G. For a failure that rendered a train of a safety system inoperable, estimated time elapsed from the discovery of the failure until the train was returned to service:

Not applicable - The failures of the CEDM cooling fans, fast transfer of the non-class 13.8 kV bus, and the SBCV not opening did not render a train of a safety system inoperable.

H. Method of discovery of each component or system failure or procedural error:

The CEDM cooling fan failures were discovered by Control Room personnel when they were annunciated and/or indicated in the control room.

The fast bus transfer failure was discovered by Control Room personnel when it was annunciated in the Control Room.

The SBCV not opening was discovered during a review of the system response data after the event.

There were no procedural errors identified.

I. Cause of Event:

The cause of the manual reactor trip was ASI approaching its limit. This is an expected plant response during an end of core life shutdown (SALP Cause Code X: other). Past industry experience shows it is difficult to maintain operating limits, especially ASI during an end of core life shutdown, particularly with large height cores.

Since the procedure for loss of all CEDM cooling fans required that the plant be shut down by boration, control rod movement was not used to maintain ASI within its limits. Although, Control Room personnel were limited in the strategies they could use to control ASI, they were aware that ASI would approach its limit during the shutdown and monitored ASI to ensure that the ASI Core Protection Channel trip setpoint was not exceeded, There were no unusual characteristics of the work location (e.g., noise, heat, or poor lighting) that contributed to the event.

J. Safety System Response:

A manual reactor trip occurred due to ASI approaching its trip setpoints on the Core Protection Calculators as described in Section I.B. No other safety systems responses occurred and none were required during this event.

K. Failed Component Information:

The CEDM cooling fans are manufactured by Joy Manufacturing. They are model number 45-26-1770.

The breakers are manufactured by General Electric Company. They are Magne-Blast model number AM-13.8-1000-4H, 3000 amp breakers.

II. ASSESSMENT OF THE SAFETY CONSEQUENCES AND IMPLICATIONS OF THIS
EVENT:

The reactor trip was manually initiated prior to the reactor exceeding a Core Protection Calculator trip setpoint and was diagnosed as an uncomplicated reactor trip. The partial loss of forced circulation (i.e. loss of two (2) RCPs due to fast bus transfer failure) is bounded by the total loss of flow analysis in Chapter 15 of the Updated Final Safety Analysis Report. No safety system response was required. The

event did not result in any challenges to fission product barriers or result in any releases of radioactive materials. Therefore, there were no safety consequences or implications as

a result of this event. This event did not adversely affect the health and safety of the public.

III. CORRECTIVE ACTION:

A. Immediate:

1. The reactor was manually tripped to ensure the ASI Core Protection Channel trip setpoint was not exceeded.

B. Action to Prevent Recurrence:

1. Because of the reactor core physical characteristics and the procedural requirement for a borated shutdown within 30 minutes due to the CEDM fan failures, there is a high potential for ASI to reach a value that would require a manual or automatic reactor trip during this shutdown scenario. PVNGS engineering has reevaluated the requirement for a borated shutdown when there is a loss of CEDM cooling fans. It was determined that minimum control rod movement for ASI control is acceptable during a shutdown due to loss of CEDM cooling fans. Procedures have been revised to incorporate this change.

2. Three (3) of the four (4) CEDM cooling fans were replaced. One (1) CEDM cooling fan will be replaced during the Unit 2 refueling outage scheduled to start October 17, 1991. The CEDM cooling fans in Units 1 and 3 are scheduled to be replaced or reworked during the next refueling outage. A root cause of failure investigation is expected to be completed by May 1, 1992. This investigation should provide recommendations to improve CEDM cooling fan reliability.

3. The fast bus transfer breakers, including the early 'b' contact, have been inspected in both busses in Units 1, 2 and 3. No deficiencies were found during these inspections. The Unit 2 and 3 early 'b' contacts have been response time tested, All times were within the allowed response time. The Unit 1 early 'b' contacts are scheduled to be tested during the next refueling outage scheduled for the first quarter 1992, The maintenance procedure for these breakers is also being revised to include timing of the early 'b' contact. The procedure change is expected to be completed by December 31, 1991.

4. The cause of the SBCV not modulating open could not be determined. The SBCV operated satisfactorily during testing following this event. The Unit 2 SBCVs have previously been scheduled to be inspected during the next refueling outage scheduled to start October 17, 1991.

IV. PREVIOUS SIMILAR EVENTS:

LER 528/87-018-01 described an event where the reactor tripped during an end of core life shutdown. The reactor was being shut down to evaluate a possible Reactor Coolant System leak. The reactor trip was automatically initiated when the Core Protection Calculator generated a trip signal to the Plant Protection System due to ASI exceeding limits. The root cause of the event was a deficient procedure. The procedure did not contain sufficient strategies for controlling ASI at the end of core life. The procedure was updated to include strategies for controlling ASI during an end of core life shutdown. These strategies include control rod movement.

LER 529/90-001-00 described an event where the reactor was manually tripped during a planned shutdown for a refueling outage. The reactor was manually tripped because ASI was approaching its trip setpoint on the Core Protection Calculator. Strategies were implemented for controlling ASI in accordance with the approved procedure. However, the reactor core physical characteristics resulted in ASI approaching its limits during an end of core life shutdown. Therefore, the corrective action could not have prevented this event even though strategies for controlling ASI were used in accordance with an approved procedure.

Although these are similar events, the corrective actions from the previous events could not have prevented the event described in this report. The strategies for controlling ASI could not be fully implemented since a 30 minute borated shutdown was required and control rod movement was not used to control ASI due to the loss of CEDM cooling fans. Although, Control Room personnel were limited in the strategies they could use to control ASI, they were aware that ASI would approach its limit during the shutdown and monitored ASI to ensure that the ASI Core Protection Channel trip setpoint was not exceeded.

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192-00738-JML/TRB/RKR
JAMES M. LEVINE September 5, 1991
VICE PRESIDENT
NUCLEAR PRODUCTION

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Mail Station P1-37
Washington, D.C. 20555

Dear Sirs:

Subject: Palo Verde Nuclear Generating Station (PVNGS)
Unit 2
Docket No. STN 50-529 (License No. NPF-51)
Licensee Event Report 91-003-00
File: 91-020-404

Attached please find Licensee Event Report (LER) No. 91-003-00 prepared and submitted pursuant to 10CFR50.73. In accordance with 10CFR50.73(d), we are forwarding a copy of the LER to the Regional Administrator of the Region V office.

If you have any questions, please contact T. R. Bradish, Compliance Manager at (602) 393-2521.

Very truly yours,

JML/TRB/RKR/nk

Attachment

cc: W. F. Conway (all with attachment)
J. B. Martin
D. H. Coe
A. C. Gehr
A. H. Gutterman
INPO Records Center

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